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(56) Documents Cited
GB 1599607 A EP 0388200 A2
WO 1998/056331 A1 WO 1997/047262 A1
US 6080120 A US 5814003 A
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(54) Abstract Title
Inflatable compression sleeve

(57) An inflatable compression sleeve for applying graduated pressure to a limb, in order to reduce the likelihood of deep vein thrombosis, comprises: a wrap around garter 1 with inflatable means 4, and means 7 and 8 to secure the sleeve around a limb. The inflatable means may comprise a bladder with tapering airways (4, Fig 1) or different sized pads (4, Fig 5) or tubes whose spacing varies across the garter (4, Fig 6).

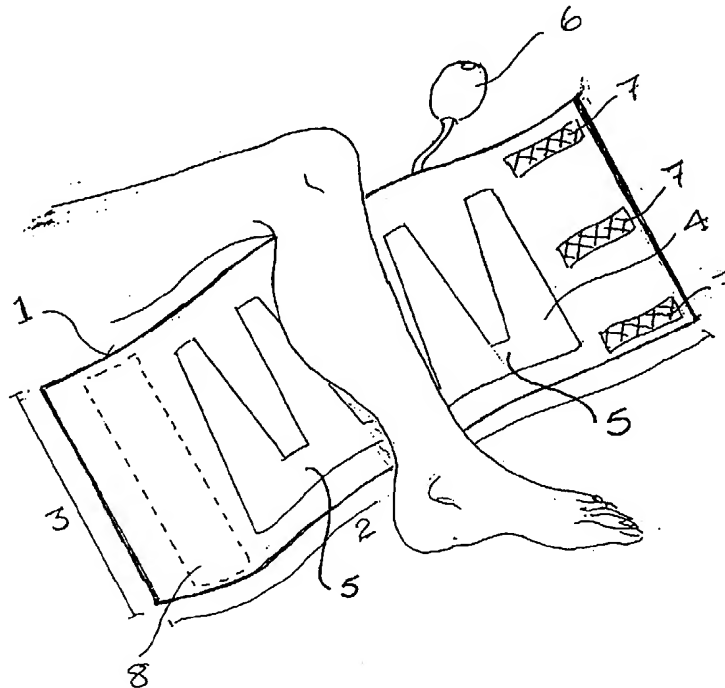


Figure No 1

GB 2 373 444 A

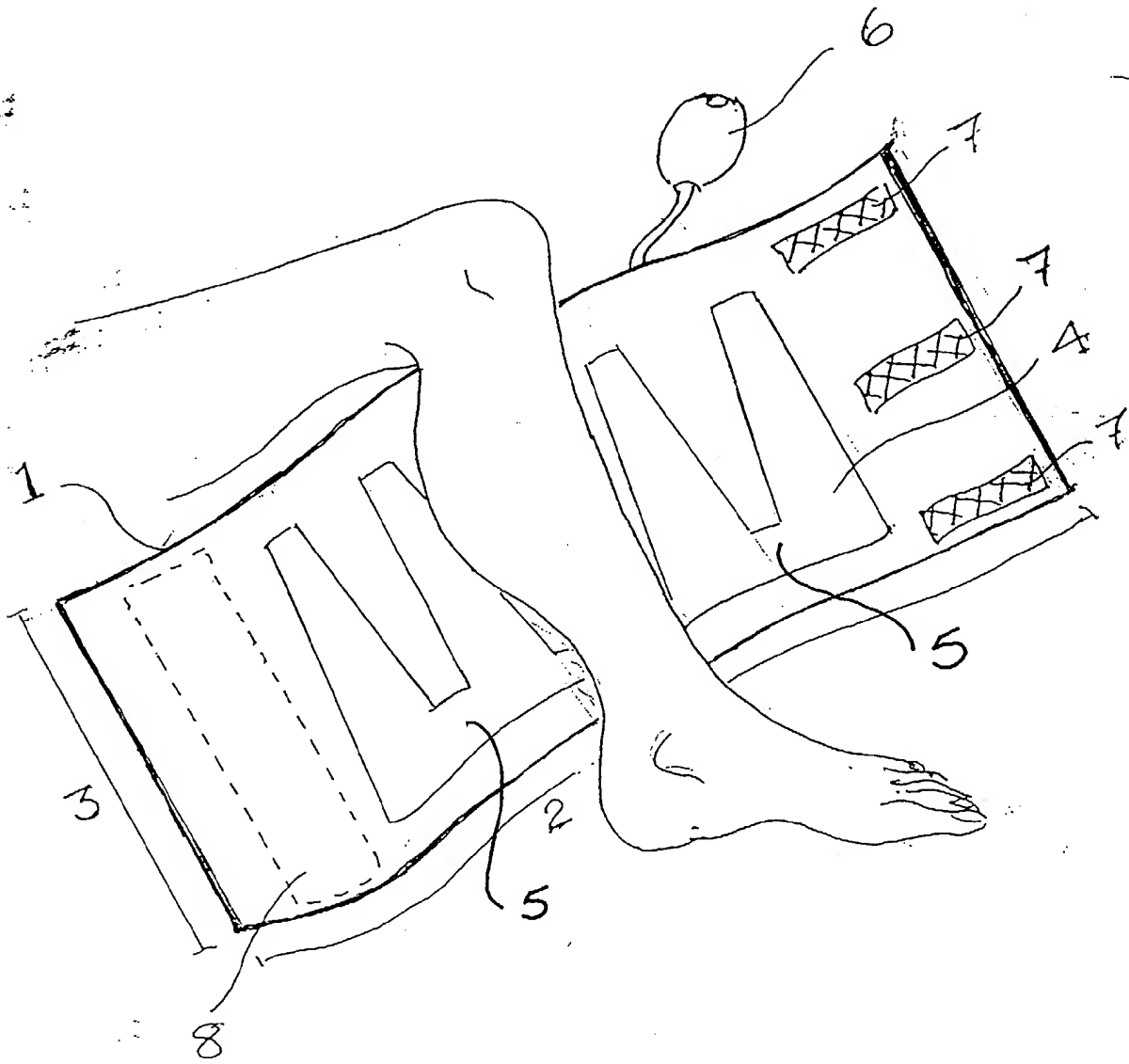


Figure No 1

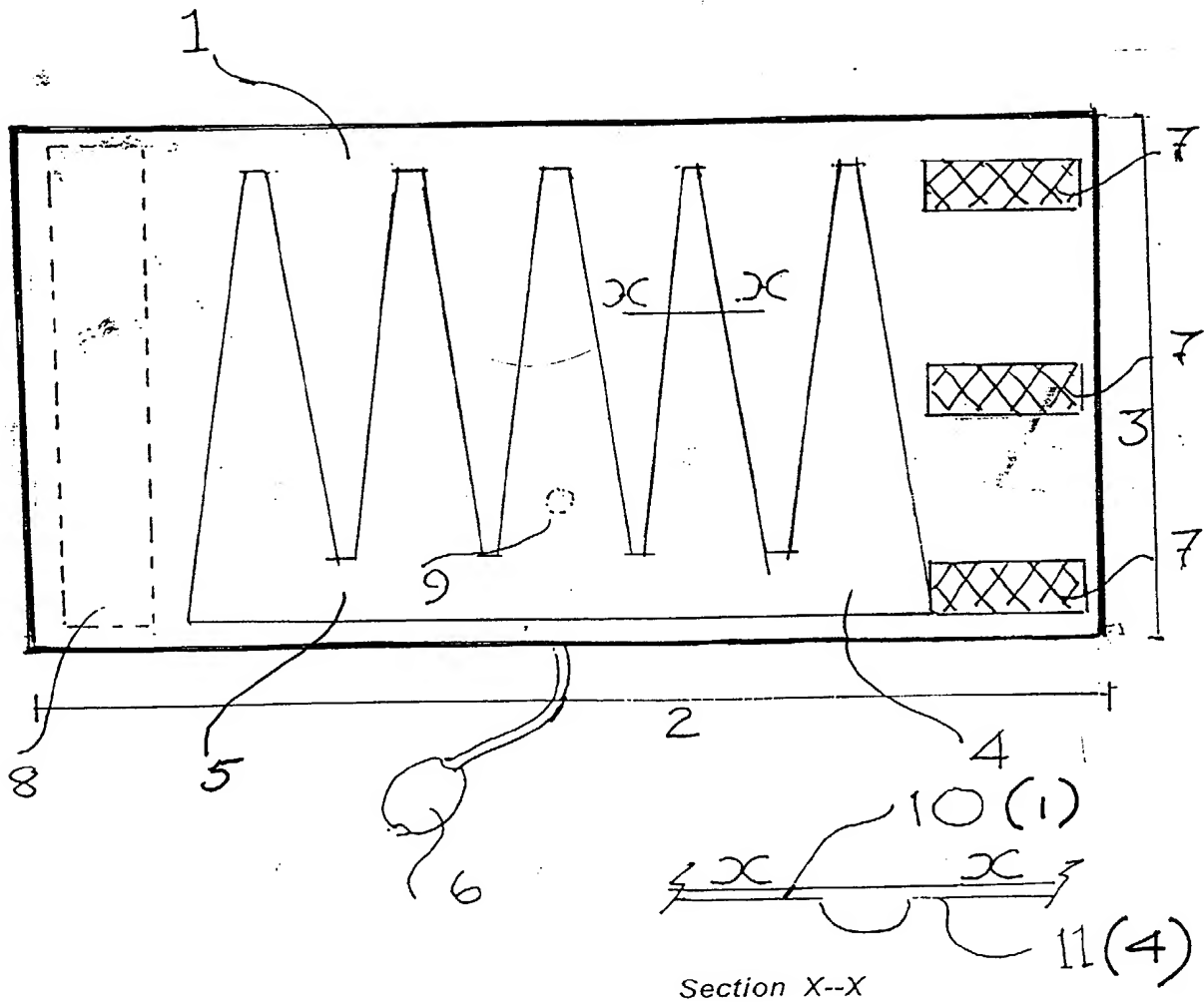


Figure No 2

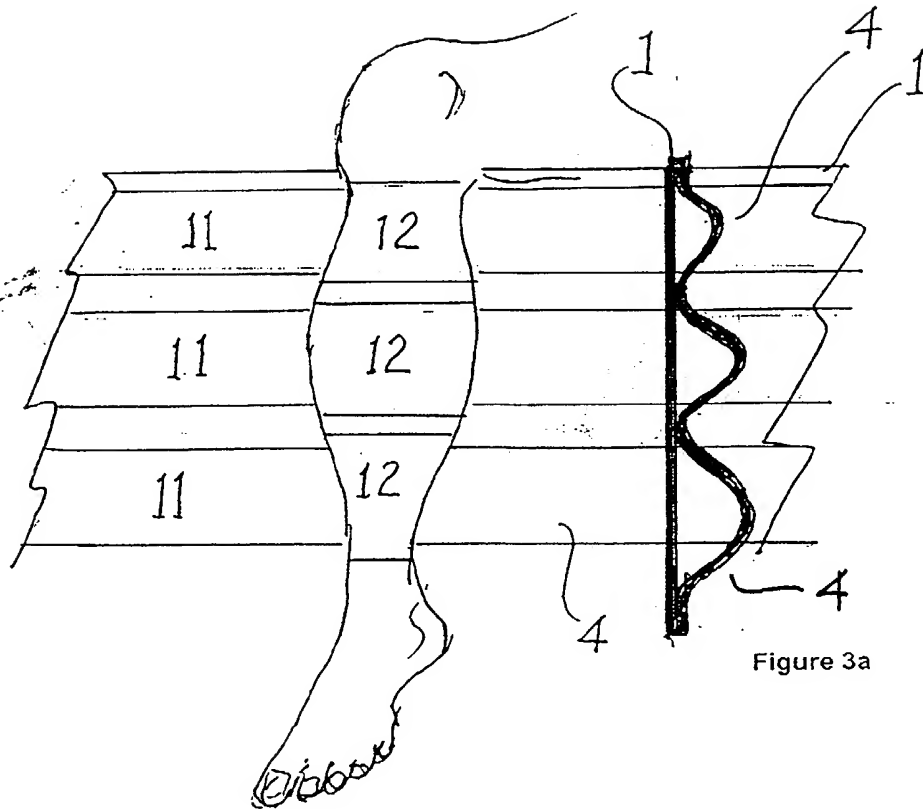


Figure No 3

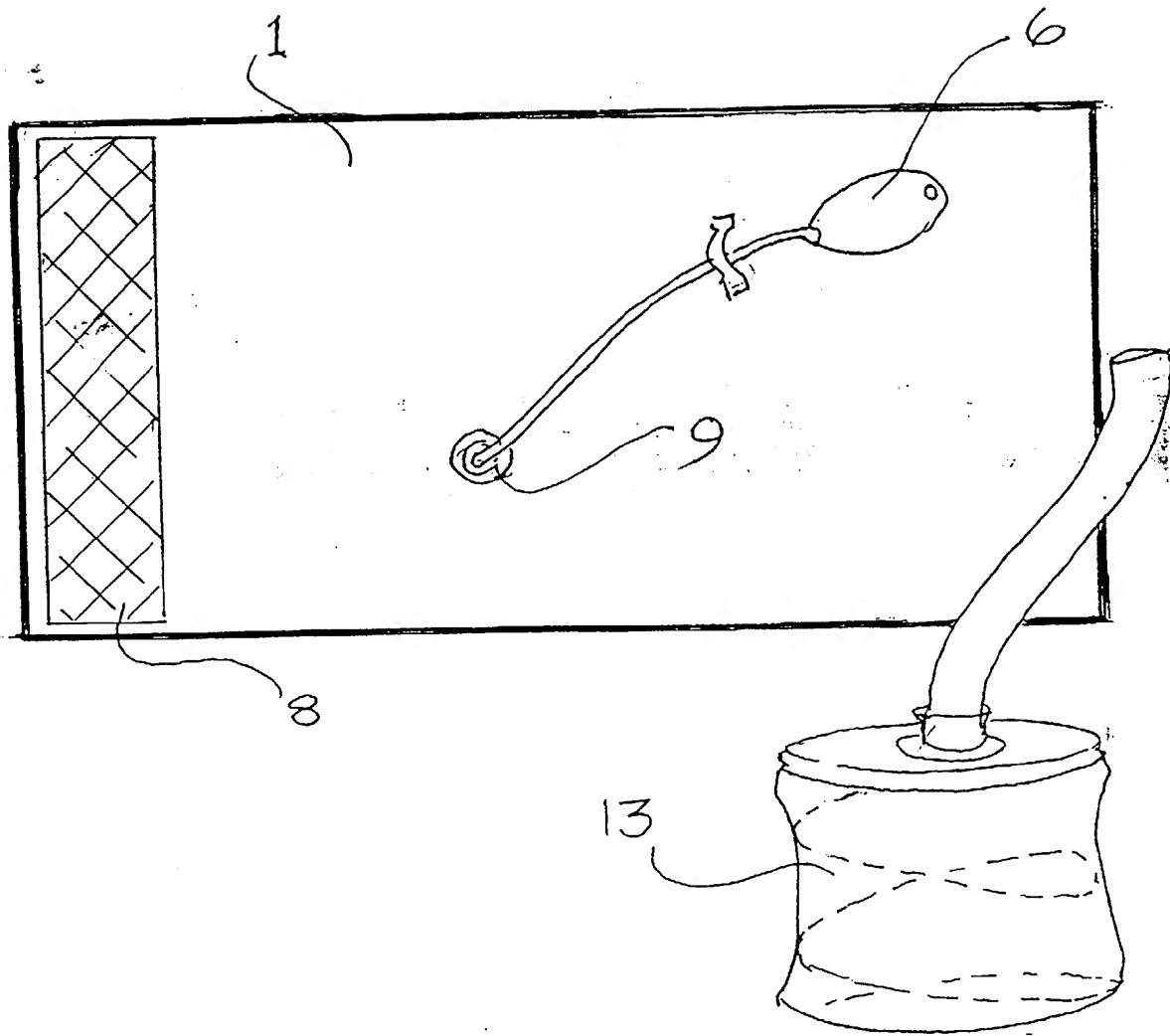


Figure No 4

Figure 4a

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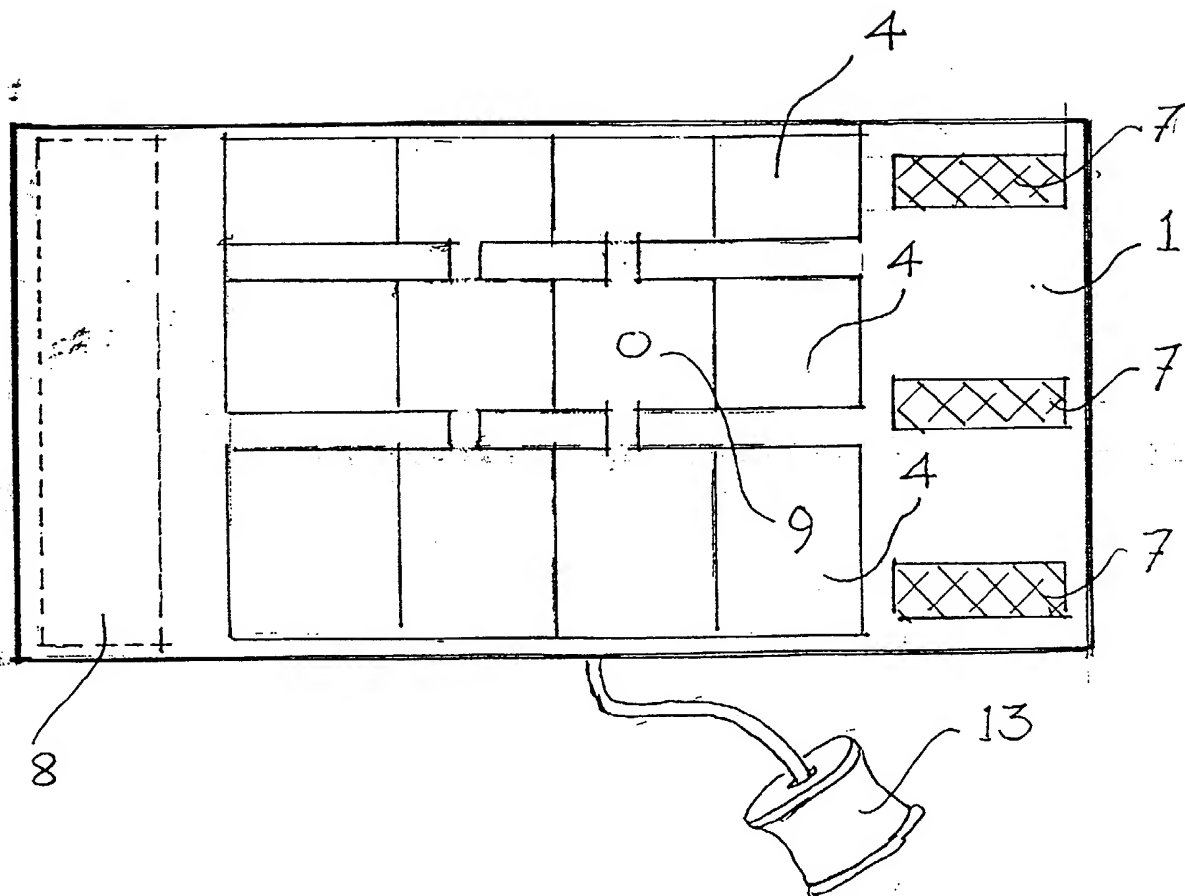


Figure No 5

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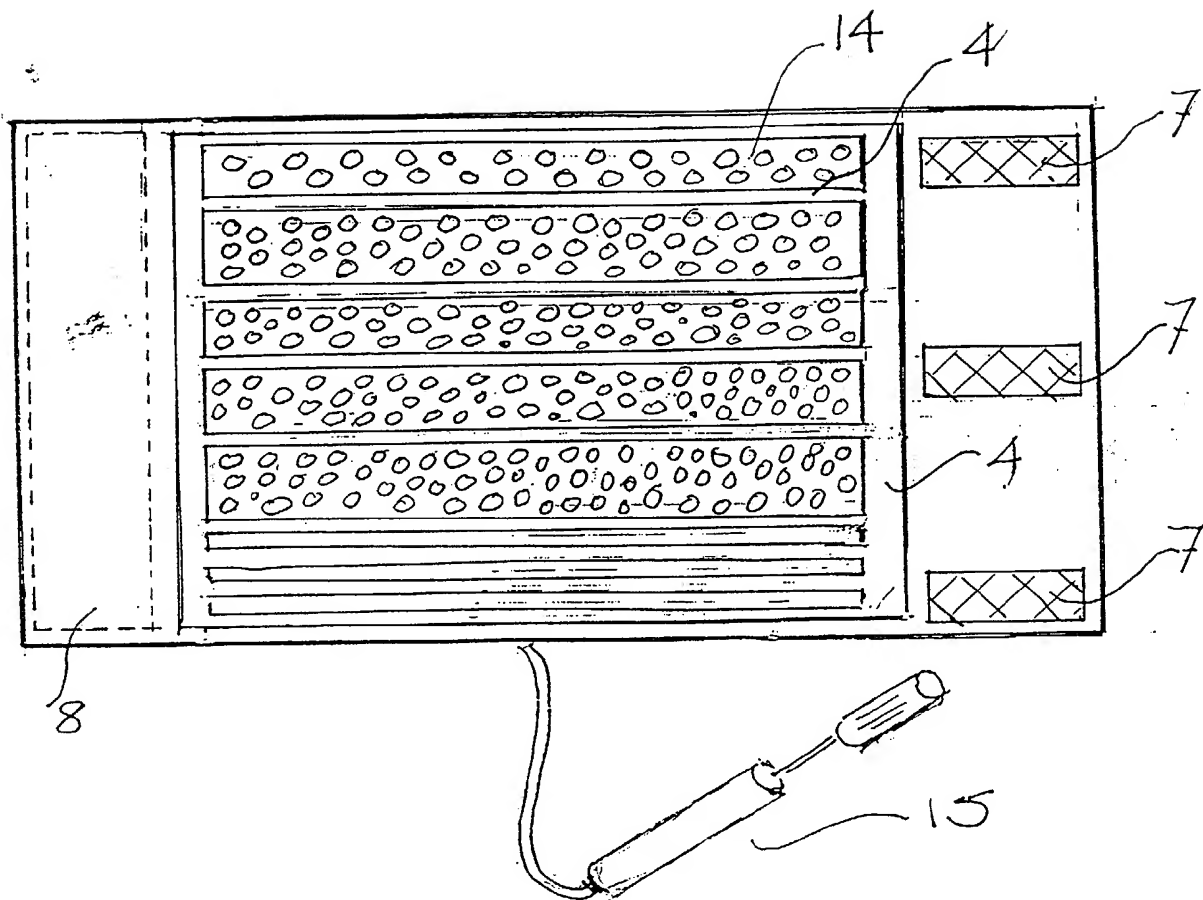


Figure No6

THE DESCRIPTION

A portable graduated pressure-inducing device to diminish the risk of deep vein thrombosis in passengers

BACKGROUND AND PROBLEM

This invention is designed primarily, although not exclusively, for travellers who, if relatively inactive over long periods during their journey (as for example but not confined to, intercontinental flights) may be at greater risk to their health, than might normally be the case, due to the enhanced possibility that they may suffer a deep vein thrombosis.

Deep venous thrombosis of the leg and pulmonary embolism continue to be significant causes of postoperative morbidity and mortality, killing 1 in 10,000 men, and 1.5 in 10,000 women each year in England and Wales. In the United States of America, pulmonary embolism is responsible for between 100,000 and 200,000 deaths each year, and over 850,000 people suffer from chronic leg ulcers due to a previous deep vein thrombosis.

In the United Kingdom alone it has been estimated that some 27,000 people die unnecessarily each year from pulmonary embolism. Further, it has been estimated that over 22,000 of these deaths could have been avoided by suitable prophylaxis to prevent the formation of deep vein thrombosis.

According to well-respected medical opinion: - (Dr. Lowe. "Combating dangers of deep vein thrombosis", 1991. 28th February: 41-48) (Parker-Williams J, Vickers R, "Major orthopaedic surgery on the leg and thromboembolism: Prophylaxis now or negligence claims later." *British Medical Journal* 1991: 303; 531; 532.)(And many other notable medical sources) suitable prophylaxis is the only practical way to substantially reduce mortality from deep vein thrombosis and pulmonary embolism.

More recent evidence suggests that globally the numbers who die annually from deep vein thrombosis runs into hundreds of thousands and that a primary cause of such mortality is the numbers who travel long distances in comparatively confined conditions, such as aircraft, coaches and trains.

Whilst there remains much to be investigated and researched, with the weight of medical opinion favouring the employment of some form of prophylaxis to ameliorate the possibility of deep vein thrombosis occurring during or shortly after long haul journeys, there is seen to exist a need for a suitable prophylactic appliance that travellers may and will wear and which, it is believed, will afford a measure of protection against the condition.

It is of equal importance to recognise that the traveller's disposition in these matters is of prime importance for, if like the seat belt, the application of or the wearing of an appliance is irksome, no matter that it may save the wearer's life, short of undesirable compulsion, there will be many who will choose not to wear the appliance. Thus, to be effective, the prophylactic appliance must have user-friendly characteristics as well as being clinically efficacious.

There are a wide range of prophylactic devices designed to afford protection against deep vein thrombosis, all of which would appear to suffer from one or more defect

when consideration is given as to whether it is an effective device for prophylactic treatment of semi-mobile long distance passengers. Before listing these defects, it is of importance to recognise that protection against the possibility of the occurrence of deep veined thrombosis can be achieved by compression.

- The most common form of prophylactic device that has been in use is the surgical antiembolism stocking. However Dr S. Thomas, the Director of the Surgical Materials Testing Laboratory, Princess of Wales Hospital, Bridgend, reported that as long ago as 1973 Siegel had questioned the use of a single chambered compression sleeve as an efficient prophylactic apparatus. Subsequent research has resulted in a large body of opinion that has defined the characteristics of the ideal compression device, (as reported by Doctors Stephen Thomas B.Pharm., Ph.D., M.R.Pharm.S.; Nicole Toyick., H'N'C., (App Biol.); and Bruce Fisher BSc., B.Pharm. M.R.Pharm.S, the authors of "Graduated External Compression and the Prevention of Deep Vein Thrombosis published in 2000

Taking three pressure measurement zones, viz.: ankle, calf and knee, the pressures recommended by Siegel and by Lawrence and Kakkar with arbitrary allowance limits of + or - 20% are as follows:-

| Location | Nominal Pressure (mmHg) | % | Limits Adopted (mmHg) |
|----------|----------------------------|----|--------------------------|
| Ankle | 18 | 45 | 14.4-21.6 |
| Calf | 14 | 35 | 11.2-16.8 |
| Knee | 8 | 20 | 6.4- 9.6 |

Upon experimentation Lawrence and Kakkar found and reported that, "When pressure was applied to the lower leg only, the increase in blood velocity was not

significantly different from that produced when the entire limb was compressed, suggesting that compression of the limb below the knee contributes most to the increase of velocity of blood to the femoral vein."

Thus a prerequisite of an effective (DVT) prophylactic device is that it should have graduated compression zones.

In respect of passengers and in particular long haul aircraft, train and coach passengers who wish to take precautions against a deep vein thrombosis there is a need for the prophylactic device to be portable and convenient.

There are several other factors which desirably should apply to an optimal solution (insofar as the state of the art permits) for travellers who wish to afford themselves some measure of protection. However, until now, no prophylactic invention has avoided all the disadvantages, whilst incorporating all the perceived advantages, necessary for an optimal device.

Many forms of external support and compression devices are currently available, including pre-eminently, the "surgical stocking," which appliance commonly consists of a woven elasticised stocking that in most instances extends from the instep of the foot to immediately below the knee. However these and all other known forms of devices designed to reduce the possibility of the occurrence of deep vein thrombosis, suffer from one or more of the following defects or impediments to their use.

- 1) They are required to be of an unachievably precise (or nearly precise) size in every case, in order that they fit the user.

This means that: -

- a) Preferably, there has to be a formal or semi skilled informal fitting session involving a degree of specialist knowledge. Alternatively there must be allowance within the appliance for variations in size. In this and other situations, the effectiveness of the device is, in many cases, compromised because the appliance fits inadequately.
- b) To be universally effective the product has to be produced in a number of ranges or sizes with the consequent adverse effect on cost and upon availability of the required range or size that is in stock at the point of sale.
- c) Potential purchasers are deterred from acquiring a device because of the complexities relating to accurate sizing and fitting and by the consequent doubt as to that which they should purchase.
- d) Because of the several impediments in effective use and in particular the need to supply several options in respect of size, prime users, such as airlines and long distant bus companies are understandably deterred from bulk purchasing an appliance for redistribution to their customers. Accordingly the fact that there are impediments to effective use, which in turn inhibits bulk purchase, means that there is created another major obstruction to wide scale use of such appliances.
- e) In addition to the aforementioned impediments to wide scale adoption and use, compression stockings can be difficult for the would-be user to put on and remove, particularly whilst in a confined space such as an aircraft seat.

- 2) Most desirably, appliances require to be made so that there is an in-built variation in pressure zones. Thus zones recognised as requiring more or less pressure, need the appliance to be constructed in a way that delivers, or permits, the optimum benefit to those zones. Within appliances readily available to the public such zoning either does not exist, is only partially effective, or is achieved by complex means with undesirable gadgetry.

This means that: -

- a) Contrary to that which is readily available to the public, the design should be such that the compression distinctions are virtually automatically achieved or are easily produced in the required zones. Further, these zonal variations should desirably be achievable without reliance on the technical or clinical knowledge of the user.
- b) The compression characteristics should allow for the distinctions in size and shape of the intended user no matter that the user's size and proportions are unknown at the time of acquisition. Such requirement would presuppose that the appliance would be adjustable in respect of its ability to accurately target the required zones and thereafter apply the appropriate degree of compression. Adjustable stockings or other devices with the aforementioned characteristics are not available.
- c) The pressure must be capable of being quickly applied and released, in order to ensure minimum inconvenience to the user. These facilities are not commonly available and when they are, the device is perceived to have other disadvantages.

- 3) Unlike appliances that currently exist, a satisfactory solution should include that the device should be easily applied and removed.

This means that: -

- a) The appliance should be able to be fitted and removed in a range of difficult environments. (By way of example; whilst confined to an economy class aircraft seat.)
 - b) The fitting and removal should be capable of being carried out quickly by unskilled users.
 - c) Instructions in respect of the use of the appliance should be capable of being simplified to the point where only diagrams and no words are used, Thus instructions in respect of the use of an acceptable device would be universally available to all travellers regardless of their nationality or language skills.
- 4) The device should be light and portable. Unlike many of the designs produced to cater for the problem (many of which are intended for static situations such as hospital beds and operating theatres) the device should not interfere unduly with the wearer's mobility.
- a) The device should not have switches, batteries, motors, or other sophisticated equipment, which add to both the cost and bulk, and which is more likely to become damaged, disconnected, switched on or off accidentally, and or otherwise be adversely affected by the movement of the wearer.

- b) The device should not be bulky or have protrusions which may greatly inhibit the movement of the wearer.
 - c) It should be able to be packaged and stored in a small container or bag permitting inter alia its convenient use in quantity on aircraft and in other situations where criteria of weight and bulk are of importance.
 - d) The product and packaging should be light in weight, both in respect of the comfort of the wearer and for the convenience of the distributor.
Particularly where weight is a prime factor in transport cost.
- 5) In the interests of economy and the perceived value to the purchaser, the device should be reusable. In the alternative, the device should be so inexpensive as to be regarded by the purchaser as disposable.
- 6) The device should lend itself to being mass produced in that:-
- a) It should be simple in design.
 - b) It should be made of readily available materials
- 7) Simplicity of design and other economic considerations will induce availability and use, leading to a saving in life. An ideal solution to most criteria that concerns user-acceptability, purchase and use, is that the device should be able to be manufactured so economically as to afford the possibility of it being included by the airline, coach, or rail company within the price paid for the journey and thus appearing to the passenger as being provided free. Other

devices currently available do not readily lend themselves to this end and thus there is a consequent limitation on their use and upon the benefits that their use would entail.

The Device which is hereinafter described overcomes all the aforementioned limitations of other devices whilst adopting and incorporating the desirable elements outlined above.

PRIOR ART

In the envisaged circumstances of its intended use, the invention is superior to all previous designs, and the previous state of the art, in respect of its range of characteristics. Its express intention, suitability, employment, performance and resultant efficacy, in the envisaged circumstances of its intended use, and in particular it is superior to those listed under the following patent references.

US4186732

US4183353

WO9629973

WO9526705

WO9425581

EP0589181

DE1952829245

US5782893

US5674262

US5669872

US5643331

WO9718759

US5584798

US5575762

US5556422

EP1071493

WO0072797

US6002965

US5951502

FR2762780

GB2322556

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a drawing which illustrates an embodiment of the invention, including a substantially inelastic outer skin of a shell (or gaiter) (1) which contains any outward movement due to the consequent predetermined graduated inflation pressures induced upon areas of an inner skin of the shell (4) which is so designed as to compress zones of the leg to a predetermined level. The shell is open and is thus enabled to be wrapped around the user's lower leg (with little regard to the circumference of the same) and in the preferred embodiment it is secured with self gripping strips (7) against a pad (8) or corresponding self gripping strips so as to give or slip in the event that the device is over inflated. The open gaiter with adjustable fixings allows one size of device to be suitable for a wide range of users.

Figure 1 illustrates one of the ways (method one) in which the claimed principle behind the invention is transmitted into use. The tapering airways (4) are so connected that they inflate simultaneously, creating differential pressure when contained by the inelastic outer skin. Proportionate increases in pressure governed by the dimensions and flexibility of the inner skin airways are obtainable in a number of ways. Examples of which are illustrated in other figures.

Figure 2 is a plan of the inner face of the device showing more clearly (method one) "the tapering inner skin" airways (4). The air inlet is shown at (9), that in turn is connected to a tube and thence (in the illustration at figure 1 and 2) to a manually inflating operated device in the form of a bulb. Alternative inflation devices are illustrated in other figures, any of which may be used in addition to the wearer using his mouth to inflate the apparatus.

The detail x-x accompanying figure 2 illustrates the two skins of the device and shows the expansion of the inner skin by inflation. Thus whilst the outer skin contains

any movement, the inner skin dilates and endeavours to take space that is occupied by the wearer's leg, creating pressure where contact is made.

Figure 3 is a diagram drawn to illustrate a) the term "area" in respect of the gaiter. Three areas are shown. Each are numbered (11). The corresponding "zones" on the wearer's leg are each numbered (12).

Figure 3a detailed on the above drawing, diagrammatically illustrates the movement of the flexible inner skin in an inflated mode, showing the relative degree of airway expansion in different areas.

Figure 4 shows the outside of the gaiter (1) and the self-gripping pad which is bonded to the outer skin. A bulb-type inflation device (6) is shown attached to a tube that leads to the inlet (9) into the communal airway.

Figure 4a, forming a part of Figure 4, illustrates an alternative form of manual pump (13), being a spring loaded collapsible chamber with rigid ends, in which are secured inlet and outlet valves, the latter of which is connected to a tube and hence to the air inlet to the internal flexible airway. The tube, which is of any desired length, is clipped for convenience and so as not to impede mobility, to the outer skin of the gaiter when in the stored position.

Figure 5 illustrates an alternative way (method two) of forming graduated airways to the inner flexible skin (4). This method employs a number of differing sized pads which are interconnected and which are graduated in number, size and flexibility to provide differential expansion characteristics to the gaiter's areas. The pads may be of any shape or size providing that they conform to the principle of the device and deliver pressure in the required areas to the required degree.

Figure 6 illustrates a further alternative way (method three) of forming graduated airways to the inner flexible skin. In this alternative, tubes are formed or inserted in or between the inner flexible skin in such a way as to have more tubing more closely together where greater pressure is required, graduated to the area of the device that has less tubing more widely spread so as to provide a lesser degree of pressure to that area.

Figure 6 also illustrates a further variation to the invention. In this variation holes, (14) have been made in the outer skin, to provide ventilation to the wearers leg when the device is in use. As a further aid to comfort, a thin absorbent layer of paper cloth or similar material is lightly bonded to the inner surface of the gaiter. This may be more texturally acceptable to the wearer than the chosen gaiter material, whilst assisting to absorb perspiration.

A further alternative means of inflation is illustrated (15) . This is a hand pump similar to a small bicycle pump.

As another alternative to a hand pump the device may be inflated orally.

DETAILED DESCRIPTION OF THE INVENTION

The invention is an apparatus so devised as to be able, by using air pressure, to create graduated compression to selected zones of the lower leg of passengers and others at risk, by an entirely self contained, manually operated, light, portable, and easily applied device, that permits good mobility when worn.

The drawings illustrate a range of ways that express the principal embodiment of the invention. This principle is that the dimensions and or flexibility of a given section or area of a pad or pads (including tubes), contained within an inelastic sleeve, if different from other areas in respect of its size and or flexibility from the given area, will, when inflated, create a different force to dissimilar areas.

Using the above principle, the invention is so contrived, that by the precise control of the dimensions and or flexibility of the required areas, the compression of zones of the lower leg can take place by a common form of inflation, which, by forming directed pressure, create differential compression characteristics to those selected zones than will exist in zones affected by areas of dissimilar size and or flexibility. Thus, by way of example: the greater the permissible area of inflation, the greater would be the compression on the zone that it encases.

Thus by using the above principal, correctly calculated and applied, the graduations of compression of the lower leg that are recognised by the medical profession as being necessary to assist in the avoidance of deep vein thrombosis can be created in a simple device.

In the preferred embodiment, there is formed a continuous air chamber (4), (5) in a double skinned gaiter (1) comprising an inelastic outer skin and an expandable inner skin so arranged as to occasion pre-designed areas of the inner skin to be inflated to a different extent from other areas of the gaiter which would be inflated simultaneously.

An alternative method of creating graduated compression by the use of the above explained principle would involve the deployment of a bladder or tube of the required dimensions and or flexibility, secured to the inner face of the outer casing or between the outer and inner skins of the gaiter.

In use the gaiter is wrapped around the lower part of each leg of the wearer so that it overlaps to ensure that the calf is completely encircled by the apparatus. In the preferred embodiment, the whole is secured by a system of self gripping strips (such as Velcro) (7) so placed as to attach themselves to a pad of similar material (8) inwards of the other edge of the gaiter, thus binding the gaiter firmly into its required position.

In the preferred embodiment, the self-gripping material will be manufactured and applied in such manner as will ensure its automatic release (or slippage) in the event that the inflation of the gaiter is taken beyond desired limits.

Alternative forms of securing the device around the lower leg include straps, tapes, hooks and eyes and buttons. In all such alternatives, there would be installed a pressure device to warn when the gaiter is sufficiently inflated.

Attached to the gaiter would be a means of inflation. In the preferred embodiment this would consist of a compressible spring loaded chamber with simple inlet and outlet

valves which after being squeezed would draw air into the chamber which would then upon squeezing, propel that air via tube to the expandable inner skin or bladder.

In a further refinement of the device, the compressible spring loaded bladder's outlet valve would be so constructed as to control the pressure within the gaiter.

In alternative arrangements the inflation of the device will be achieved by an inflating bulb, pump, or by a tube to permit inflation by mouth.

A refinement of the device will incorporate holes in parts of the outer skin of the gaiter, where there is not an inflatable area, to allow the leg to have access to air.

A further refinement of the device will have a paper cloth or other lightweight breathable material on the inside of the gaiter to provide more comfort to the wearer. What has been described is a simple, economic means to assist in the prevention of deep vein thrombosis. The invention being light weight, is portable and indeed able to be worn whilst the wearer walks. In the alternative, the device is simple to put on and inflate, even in confined circumstances. Its fixing mechanism will, for most intents, make each appliance universal in its application almost regardless of the dimensions of the wearer. It has no moving parts or mechanical equipment to become damaged or to occasion injury. It is designed to be so economic in its production as to make it sufficiently affordable as to be provided free by travel operators thus ensuring its greater use and thus preserving health and life.

The whole to be provided in a light weight bag which would also contain all required instructions for use in a diagrammatic form, so that they are capable of being understood regardless of language skills of the intended user.

SUMMARY OF THE INVENTION

The subject invention improves upon the prior art by, within one apparatus, providing passengers (and others who may benefit) with a graduated compression device to reduce the risk of incurring deep vein thrombosis prophylaxis, which is lightweight, entirely self-contained, wearer operated, fully portable, and easily installed and removed.

Graduated compression is now widely and almost universally acknowledged as the principal prophylaxis for deep vein thrombosis. The subject invention is unlike complicated mechanical and intricate electrical devices that deliver graduated compression to the limbs, that require expertise in installation, use and maintenance, and which are subject to malfunction and break down,) in that the principle employed in the subject invention is such as to afford a simple static solution with all the advantages of economy, cost, lightness, ease of use, and retained mobility.

The solution used in the preferred invention is, in the preferred design, to create airways in a length of material comprised of an outer non elastic substance and an inner expandable substance, such that the airways perform to a design principle that governs the size and degree of flexibility of the areas in which the airways have been created. Pneumatic pressure applied by the wearer, by means of a simple hand pump or by other envisaged means, creates inward compression in proportion to the

characteristics of the airway, whilst any tendency to over-inflate is removed by the in-built tension regulator which is a feature of the gaiter's fixing device.

Various alternatives have been invented which give a wide range of choice in design and some flexibility in comfort ranges. However the principle remains the same throughout all these alternative forms of the gaiter.

The wide spread use of deep vein prophylaxis gaiters is calculated to have major beneficial effect on the health of passengers, particularly those who travel long distances in comparatively confined and cramped conditions

CLAIMS

We claim:-

1. The following principles and the manner in which these principles may be exploited, to the effect that:-
 - a) "Within an inelastic sleeve or other firm covering, the size and or flexibility of a given area of connected inflatable pads, forming part of an inner lining, or as a bladder inserted under a sleeve or covering, if different in size and or flexibility from inflatable pads or bladders in other connected areas, will, when all pads or bladders are inflated, create a different outward force to those pads in dissimilar areas."
 - b) That all other factors being equal, in the aforementioned circumstances, a direct correlation exists between, on the one hand, the size and flexibility of the inflatable pads or bladders, and on the other hand, the degree of outward pressure that results following the inflation thereof.
2. That the principles as stated in clauses (1a) and (1b) above are the basis of the controlled graduated compression as used in the invention.
3. A portable apparatus, that using the aforementioned principles, exerts graduated compression to the lower limbs of passengers (and others) as prophylaxis for deep vein thrombosis comprising: -
 - a) A double skinned gaiter that may be wrapped around the lower leg. The outer inelastic skin of which being bonded to an elastic inner skin.

- b) In the alternative, a gaiter similar to 3a above, except that the gaiter provides for the insertion, location and retention of an inflatable bladder or bladders, by means of a separate skin or pocket of expandable material, or by fixings to the outer shell.
- c) A prophylactic gaiter which is "universal" in its use, in that its size is adjustable, so that it will fit a wide range of different sizes of individual wearers, by virtue of the fact that it is a wrap around device (as opposed to a stocking or other continuous tubular design) with fixings that will permit the device to adapt to the circumference of the wearer's lower leg.
- d) The fixings of the gaiter in the preferred device are comprised of self-gripping material, so engineered that the fixings give or slip in the event that over inflation of the gaiter creates excessive compression.
- e) A continuous and shaped airway between the inner and outer skins of the gaiter is formed in such manner and form as will create different sizes of pockets of air in required areas of the airway.
- f) Alternative embodiments form differing shapes to the airways, or they may include the insertion of an inflatable bladder between the skins. Such alternative means of creating different sized pockets may include a wide variety of shapes, always providing that the principle set out in paragraphs 1a and 1b of this "claims" section are maintained.
- g) An inflating device consisting of a collapsible spring loaded drum with one way inlet and one way outlet to act as a pump is connected to the airway

by a short length of tubing and fastened with a clip to the outer skin of the gaiter, to stop it hanging loose.

- h) In alternative embodiments, the means of inflation may be by bulb, pump, or tube with valves, to permit inflation by mouth. Valves would be such that inlet valve is one way to permit air to be drawn into the system, the outlet valve would permit air to be passed out into the airways and would have a controlled one way action.
 - i) In addition to the aforementioned valves, there would exist a form of air release device, such as a raised outlet and captive cap situated in the body of the gaiter and connected to the airways of the same. Other means to permit the deflation of the gaiter would include: a tap, a release operation on one of the valves, or the ability to detach the inflating connecting tube, so that the airways are rendered open to the surrounding environment.
 - j) In an alternative embodiment, the gaiter material is perforated in those parts that do not form a part of the airways, so as to provide ventilation to the leg.
 - k) In an alternative embodiment, an inner lining of light absorbent material (such as paper cloth) is fixed to provide greater comfort for the wearer.
4. An invention designed and made so as to be easy to put on and to remove, easy to replace, easy to inflate, and convenient and not distressing to wear or to walk around in, which is free of electrical components, metal parts, or sophisticated mechanical components that may be a cause of failure or which

may impede movement. That is light weight, folds flat, able to be economically produced and thus able to be offered to all passengers and to others who might benefit



INVESTOR IN PEOPLE

Application No: GB 0107272.7
Claims searched: 3-4

Examiner: Peter Trickey
Date of search: 14 September 2001

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): A5R (RBE, RBQ, REYA)

Int Cl (Ed.7): A61B 17/132, 17/135, 19/12; A61F 5/01, 5/30, 5/34, 13/08

Other: Online: EPODOC, WPI, JAPIO

Documents considered to be relevant:

| Category | Identity of document and relevant passage | Relevant to claims |
|----------|--|--------------------|
| X | GB 1599607 A (Whitney) See entire document | 3-4 |
| X | WO 98/56331 A1 (ACI Medical) See entire document | 3-4 |
| X | WO 97/47262 A1 (Innothera) See entire document | 3-4 |
| X | EP 0388200 A2 (Kendall) See entire document | 3-4 |
| X | US 6080120 A (Sandman) See entire document | 3-4 |
| X | US 5814003 A (Knox) See entire document | 3-4 |
| X | US 5125400 A (Johnson) See entire document | 3-4 |
| X | US 5117812 A (McWhorter) See entire document | 3-4 |

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|---|---|---|--|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |